

A Gamma-ray Source Detected by the Fermi- LAT at the Position of Eta Carinae

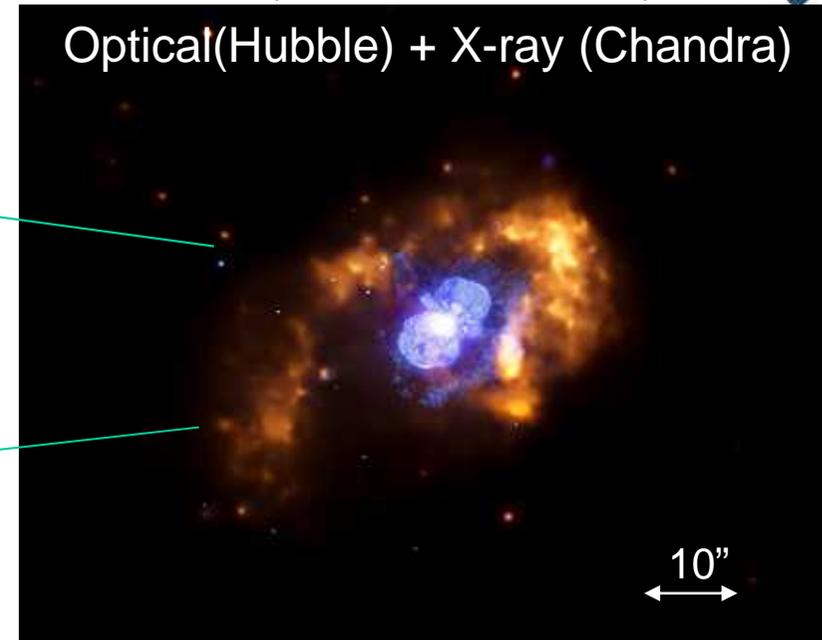
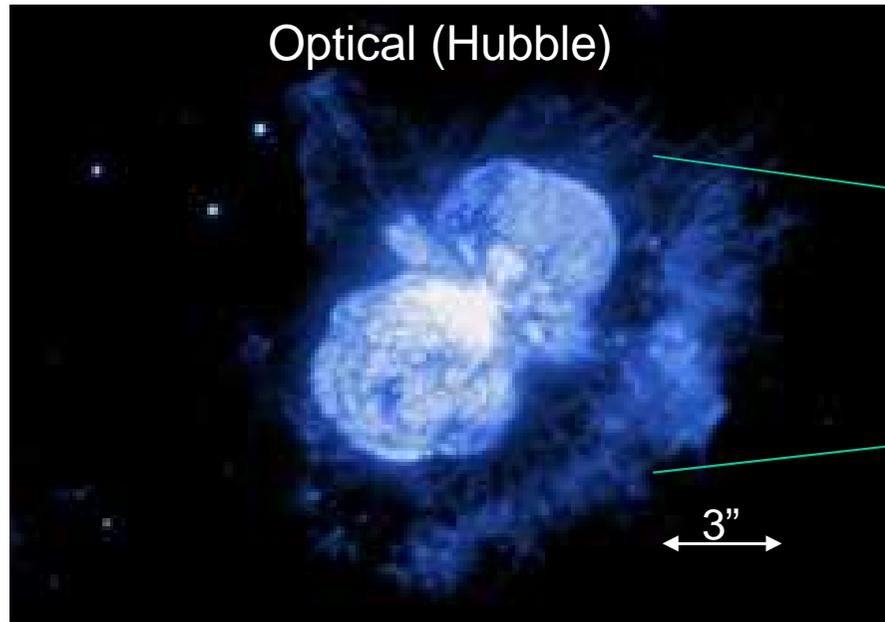
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(Hiroshima University)
On behalf of the Fermi/LAT
collaboration team

Fermi Symposium @ Washington DC
(2009/11/2-5)

Eta Carinae



(Chandra Photo Album)



- Eta Carinae is very famous with its bipolar nebula (@D~2.3 kpc).

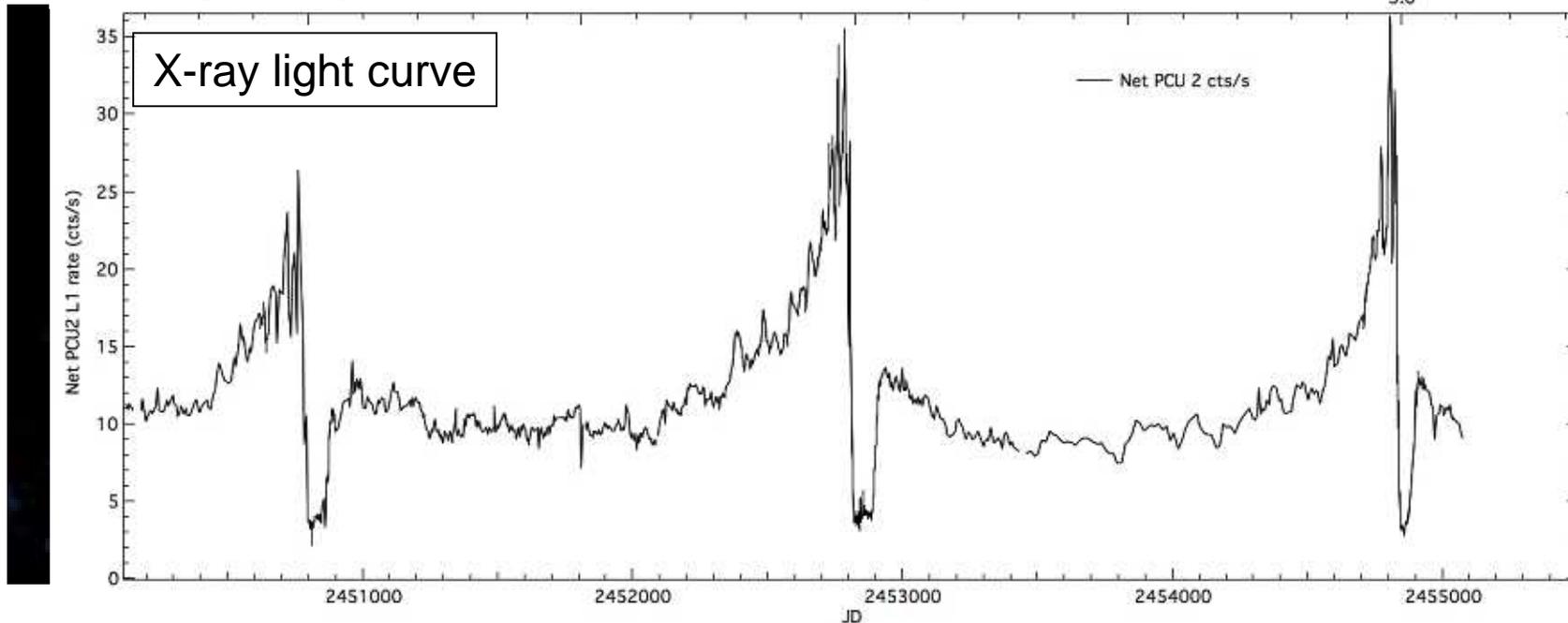
Eta Carinae



2009/01



http://asd.gsfc.nasa.gov/Michael.Corcoran/eta_car/etacar_rhte_lightcurve/index.html



- Eta Carinae is very famous with its bipolar nebula (@D~2.3 kpc).
- Because of the **period of 5.52 years**, the source is considered to be **a binary system** with itself (>80 Msolar) + companion (30 Msolar: high mass star) on the highly elliptical orbit ($e > 0.9$).

Eta Carinae

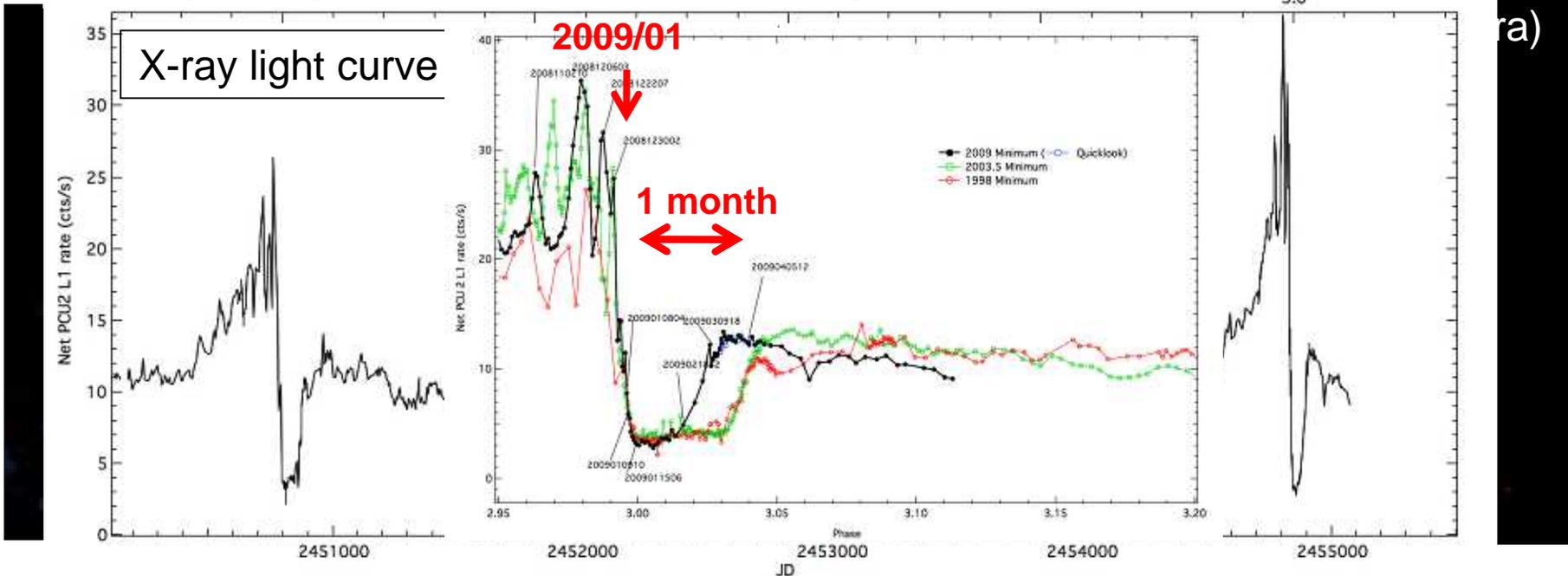


http://asd.gsfc.nasa.gov/Michael.Corcoran/eta_car/etacar_rxte_lightcurve/index.html

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3.0



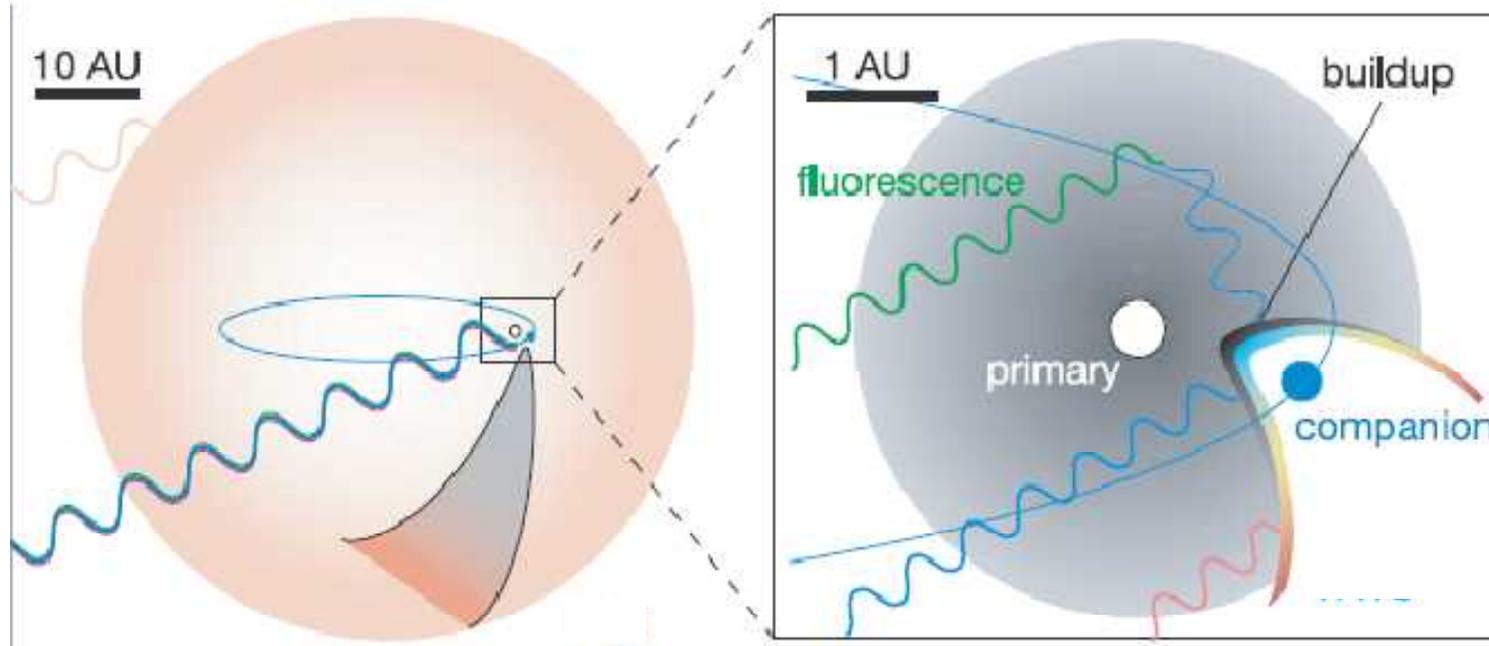
- Eta Carinae is very famous with its bipolar nebula (@D~2.3 kpc).
- Because of the **period of 5.52 years**, the source is considered to be a **binary system** with itself (>80 Msolar) + companion (30 Msolar: high mass star) on the highly elliptical orbit ($e > 0.9$).
- In 2008 Dec to 2009 Feb, Eta Carinae shows the same X-ray variability as the previous orbits (flux decreased by a factor of ~30) for a month .

Binary image of Eta Carinae



Colliding Wind Binary (CWB)

(Hamaguchi et al. 2007 ApJ 663, 522)

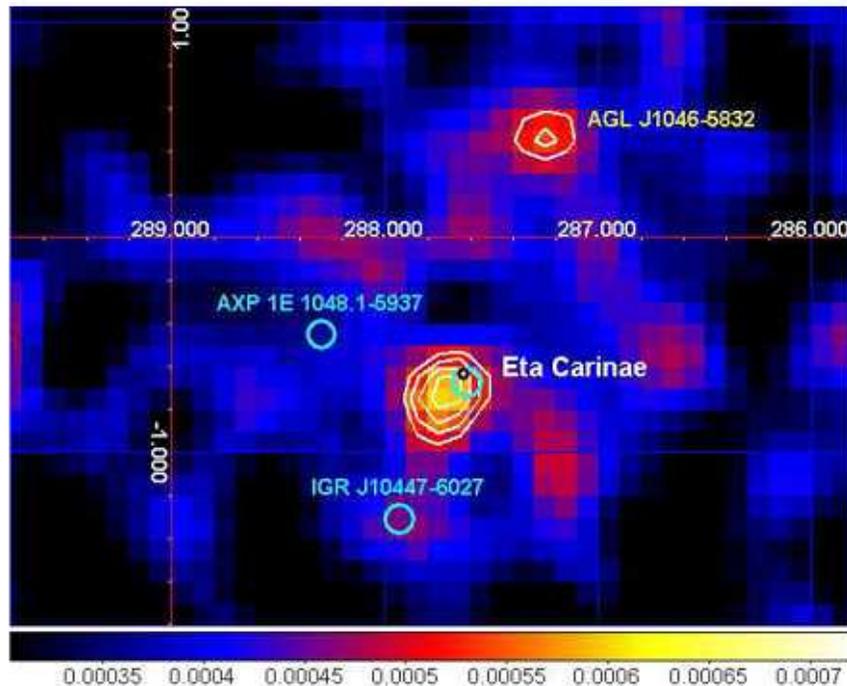


- Recently, a gamma-ray source was detected by AGILE and Fermi (Tavani et al. 2009; Abdo et al. 2009).
- There have been no gamma-ray detections from CWBs yet.
If the gamma-ray emission really comes from Eta Car, it would be the first detection of gamma-rays from a CWB.

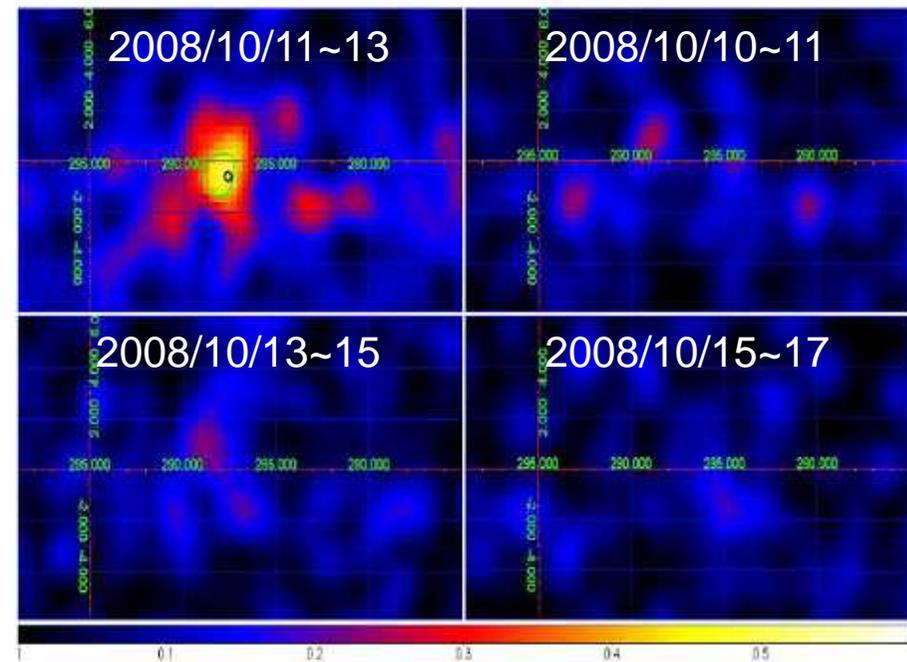


- AGILE detected one source at the position of Eta Carinae (1AGL J1043-5931). 7.8 sigma detection, $(37 \pm 5) \times 10^{-8} \text{ ph cm}^{-2} \text{ s}^{-1}$.
- The paper reported **a large flare** (the 5.2 sigma detection) during 2008/10/11–13 with a gamma-ray flux of $(270 \pm 65) \times 10^{-8} \text{ ph cm}^{-2} \text{ s}^{-1}$.

Average Count Map
(photons $\text{cm}^{-2} \text{ s}^{-1} \text{ pixel}^{-1}$)



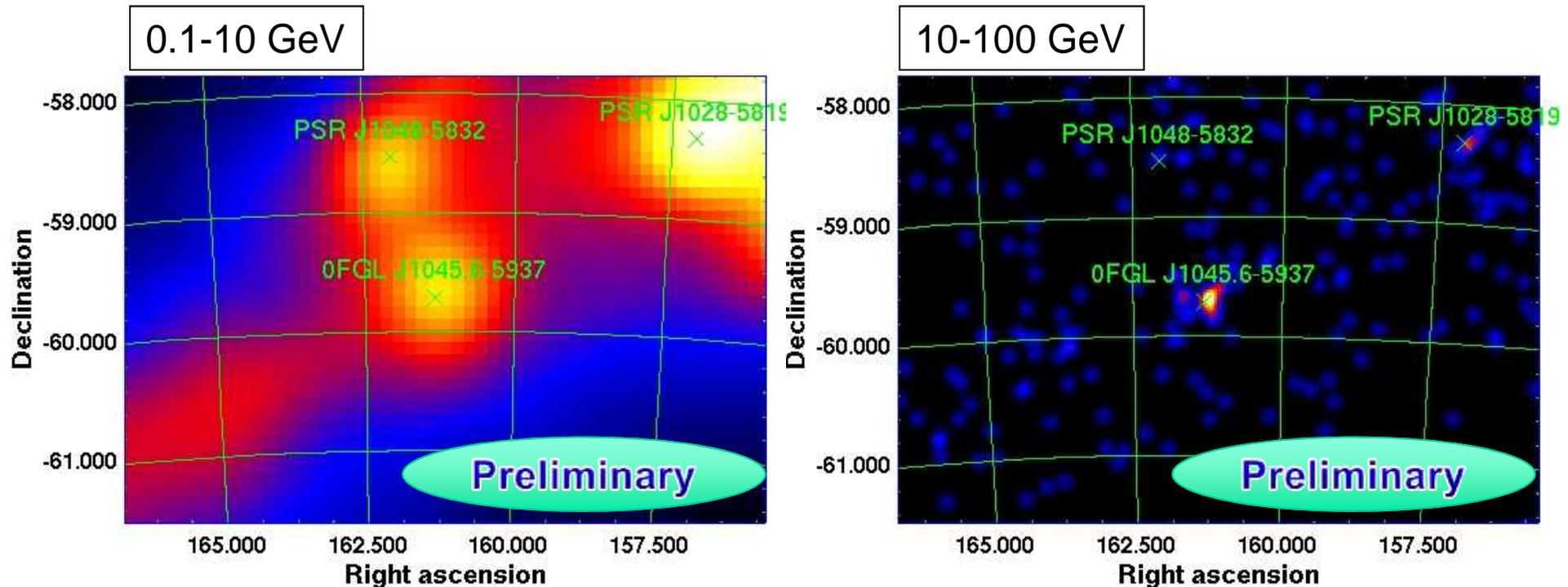
2-day bin Count Map
(counts $\text{cm}^{-2} \text{ s}^{-1} \text{ pixel}^{-1}$)



Cyan: INTEGRAL hard X-ray sources (Leyder et al. 2008)



- In Fermi bright source list, the gamma-ray source is named **0FGL J1045.6–5937** (Abdo et al. 2009, ApJS, 183, 46).

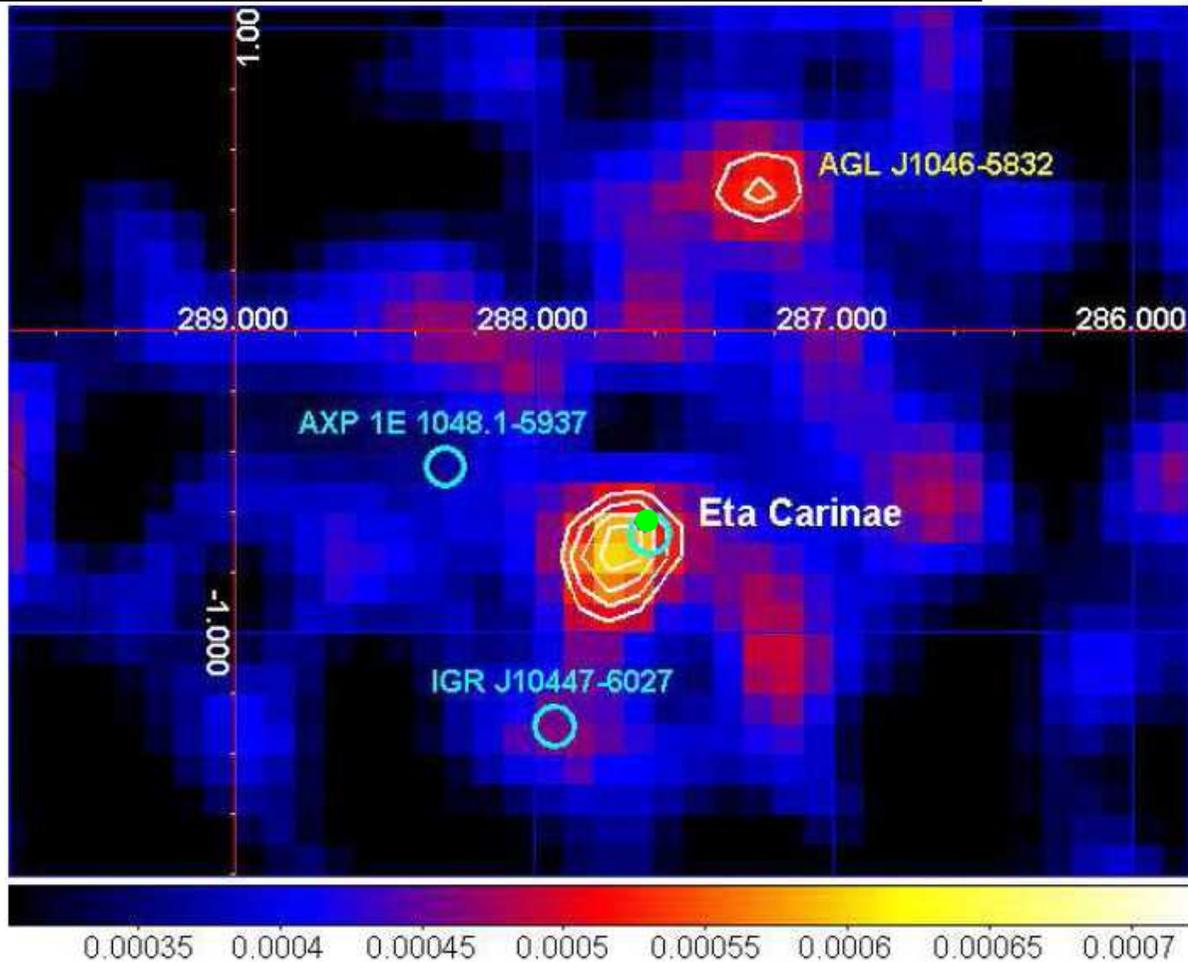


- From 2008 Aug 04 to 2009 July 23, with the DIFFUSE class
- Average flux : $3.7 (+0.3, -0.1) \times 10^{-7}$ ph cm⁻² s⁻¹ consistent with AGILE.**
- Best estimated position : (RA, Dec) = (161.265, -59.695) ± 0.030 deg.**
- Above 10 GeV, 0FGL J1045.6–5937 is the brightest in this region (brighter than the surrounding gamma-ray pulsars).**

Comparison with AGILE and X-ray



AGILE Count map (photons $\text{cm}^{-2} \text{s}^{-1} \text{pixel}^{-1}$)



AGILE error circle
 ± 0.4 deg (stat.)
 ± 0.1 (syst.)

LAT error circle
 ± 0.030 deg (stat.)
 ± 0.003 (syst.)



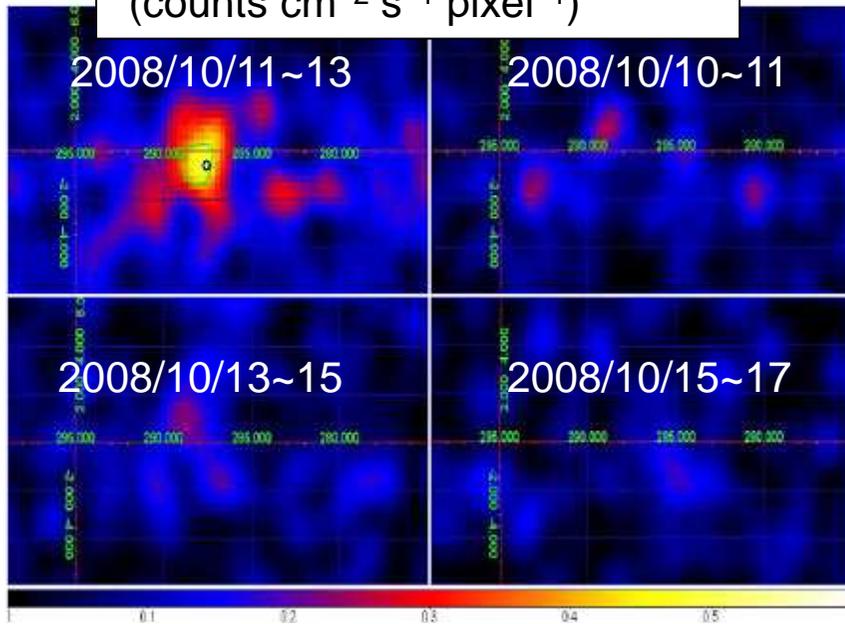
< 2 arcmin

- **Size of Fermi error circle is $\sim 1/10$ smaller (in this case) than that of AGILE, and still coincides with the position of Eta Carina.**

LAT Light Curve (Aperture photometry)

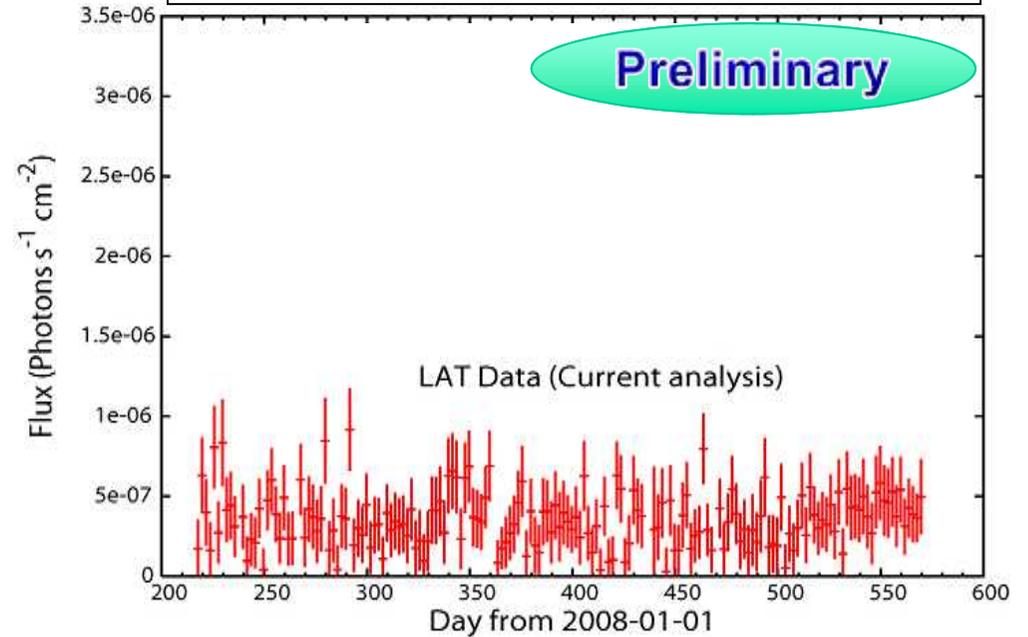


AGILE 2-day bin Count Map
(counts $\text{cm}^{-2} \text{s}^{-1} \text{pixel}^{-1}$)



AGILE reported the large flare with **5-9 times higher** than the average.

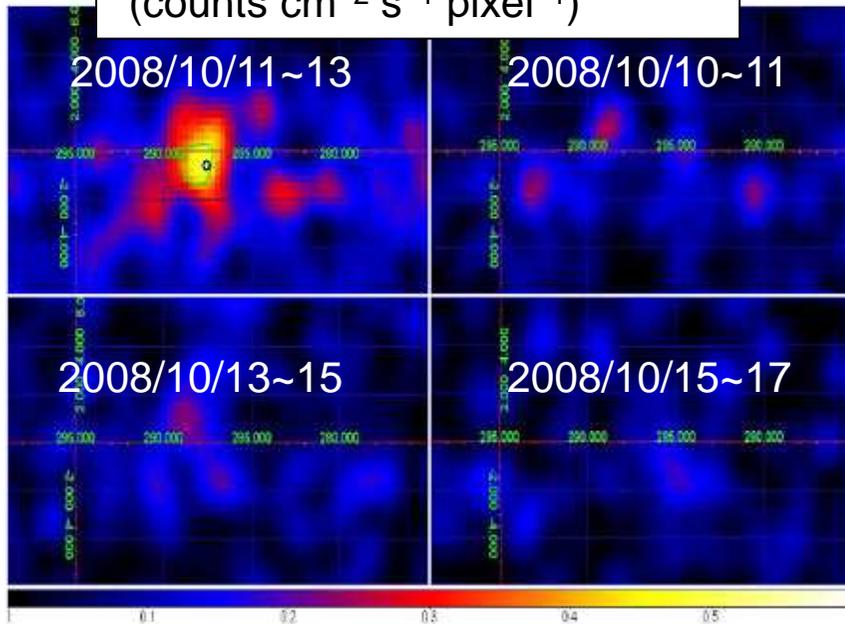
LAT 2-day bin light curve (>100 MeV within 0.5 deg) with AGILE flare



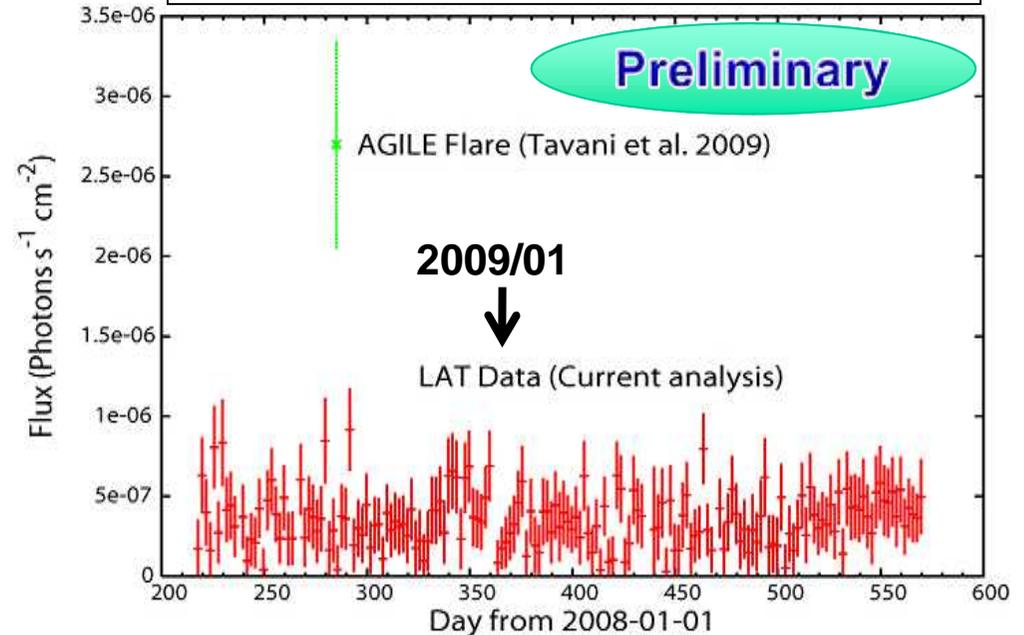
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AGILE 2-day bin Count Map
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LAT 2-day bin light curve (>100 MeV within 0.5 deg) with AGILE flare



- LAT data show the flux **at most $(9 \pm 3) \times 10^{-7} \text{ ph s}^{-1} \text{ cm}^{-2}$** consistent with the average in 2 sigma, does not confirm the AGILE flare.

However,

- The time coverage by both satellites is not the same. (Additionally, Fermi lost 4-hour data on 2008 Oct 11th).
- The flare has a possibility to be bright only below 100 MeV.

- The gamma-ray flux in 2009 Jan. does not decrease significantly compared with X-ray (a factor of ~30).**

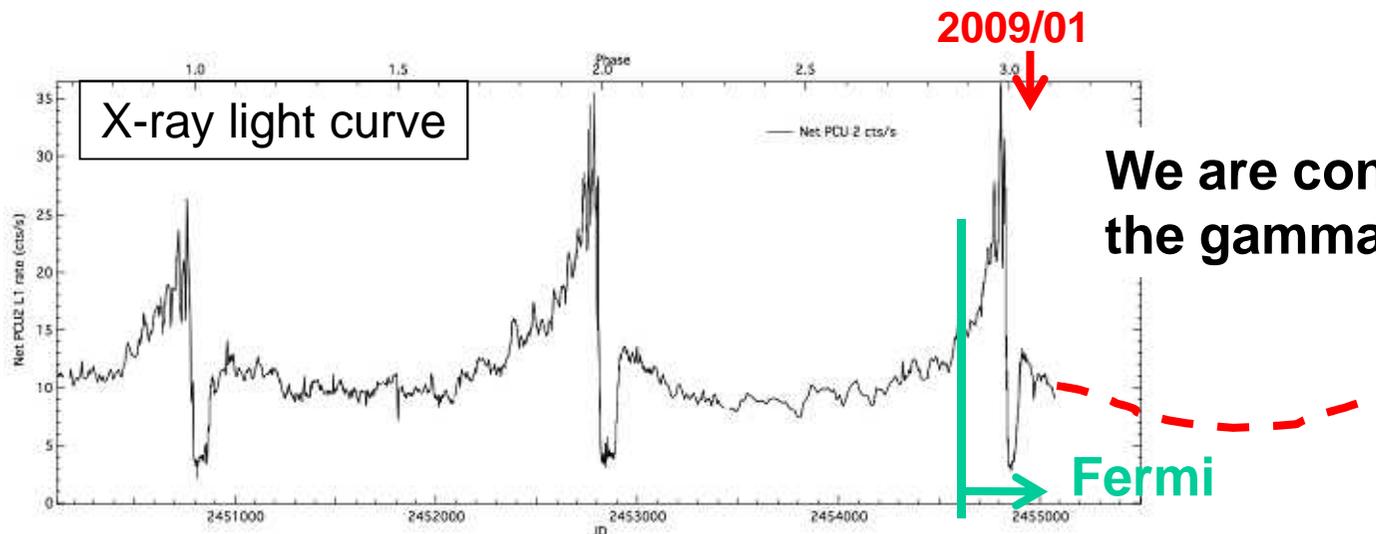
Eta Car Emits Gamma-ray ?



- The gamma-ray source locates at the position of Eta Car within the error circle (< 2 arcmin). OK
- However, the gamma-ray light curve does not show variability coinciding with the X-ray emission from Eta Car during 2009 Jan.

- **Association with Eta Car is still uncertain...** ???

- Background blazars ? (although there are no detections of such sources in this error circle.)
- Pulsars in the Carina region ?
- Really associated with Eta Car ?



We are continuously checking the gamma-ray flux.

Summary



- **AGILE and Fermi detected a gamma-ray source at the position of Eta Carinae. If the emission really comes from Eta Car, it would be the first detection of gamma-rays from a colliding wind binary.**
 - **Fermi detected the gamma-ray emission up to above 10 GeV.**
 - **The position determined by Fermi (< 2 arcmin) is ~1/10 finer than that by AGILE, and still coincides with Eta Car.**
 - **The LAT light curve does not confirm the large flare reported by AGILE, nor coincide with the large X-ray variability of Eta Car.**
 - **Association with Eta Car is still uncertain...**
 - **Background blazars ?**
 - **Pulsars in the Carina region ?**
 - **Really associated with Eta Car ?**
- Paper describing physical properties of this gamma-ray source will be upcoming soon.
- We will keep an eye on this source.